

Error in TOPEX Oscillator Drift Correction

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An error was called to our attention in the TOPEX Algorithm S1034 which corrects altimeter data for oscillator drift. We have confirmed the additive height correction should have been

$$\text{delta height} = [(R_{\text{utc}}/R_{\text{ref}}) - 1] * H,$$

where H is the uncorrected height estimate, R_{utc} is the measured spacecraft clock interval, and R_{ref} is the nominal spacecraft clock interval. In the current S1034 (used in the original processing of all TOPEX data through cycle 132); however, the expression $(R_{\text{utc}}/R_{\text{ref}})$ was erroneously inverted. The R_{utc} and R_{ref} are very close in values (parts in 10^8), therefore the upside down division effectively gives a change in sign to the correction.

This error was found by Ouan-Zan Zanife, Philippe Escudier, and Patrick Vincent, and we are grateful to them for communicating this information directly to Phil Callahan who forwarded it to us. Two important issues can be explained by the error: 1) much of the sea-level change discrepancy between TOPEX and Poseidon should disappear, and 2) the approximately 13 cm bias of TOPEX relative to Poseidon will be removed.

If there were no correction for the oscillator drift made to the TOPEX range estimate, the range after mid 1993 would become shorter with time. The current (about cycle 132) range drift rate induced by the oscillator is about 5 mm per year. The Algorithm S1034 error because of its sign doubles this rate, so that the TOPEX data product range is shorter (or the surface height greater) by about 10 mm per year.

The initial oscillator offset from the frequency used for the range conversion coefficient requires about a 65 mm range correction. This correction was applied with the wrong sign because of the S1034 error. After correcting the TOPEX range for this effect, the TOPEX range will be increased by about 13 cm.

The following table gives the range correction, in millimeters, which should be ADDED to the TOPEX range values already processed by JPL to: i) remove the effects of the S1034 error; and ii) correctly account for the oscillator drift. This correction is directly proportional to the value of the satellite height, and the table's values were produced assuming the height to be 1347 kilometers. (The TOPEX/Poseidon height varies from about 1340 kilometers at the equator to 1354 kilometers at the latitude extreme values.) Again, because of nearly identical values for R_{utc} and R_{ref} , the additive correction for the error is approximately double the value of the true oscillator drift calibration value. Because sea surface height (SSH) reported on the TOPEX GDRs is given by

$$\text{SSH} = \text{Altitude} - \text{Range} ,$$

the range correction given in the table should be SUBTRACTED from the GDR SSH:

$$\text{TOPEX GDR SSH corrected for Osc Drift error} = \text{GDR_SSH} - \text{additive_GDR_range_corr} .$$

The midpoint times in the table are calculated, not actual, but should be good to within about 10 seconds of the actual values.

Users of the Merged GDR, whether PO-DAAC or AVISO, should correct the range before forming the SSH. The correction should be applied to all the originally processed TOPEX data for cycles 1 through 132. Data from cycle 133 onward will be corrected for this effect as well as having revised software for tides and other algorithms as previously announced.

Cycle	Cycle midpoint date & time	Cycle midpoint J2000 seconds	Additive corr to GDR range, mm
001	1992-272T02:37:21	-229080159	130.60
002	1992-282T00:35:53	-228223447	130.10
003	1992-291T22:34:24	-227366736	129.63
004	1992-301T20:32:56	-226510024	129.16
005	1992-311T18:31:28	-225653312	128.72
006	1992-321T16:29:59	-224796601	128.32
007	1992-331T14:28:31	-223939889	127.95
008	1992-341T12:27:02	-223083178	127.59
009	1992-351T10:25:34	-222226466	127.23
010	1992-361T08:24:05	-221369755	126.89
011	1993-005T06:22:37	-220513043	126.59
012	1993-015T04:21:08	-219656332	126.33
013	1993-025T02:19:40	-218799620	126.09
014	1993-035T00:18:11	-217942909	125.85
015	1993-044T22:16:43	-217086197	125.65
016	1993-054T20:15:15	-216229485	125.46
017	1993-064T18:13:46	-215372774	125.31

Cycle	Cycle midpoint date & time	Cycle midpoint J2000 seconds	Additive corr to GDR range, mm
018	1993-074T16:12:18	-214516062	125.18
019	1993-084T14:10:49	-213659351	125.07
020	1993-094T12:09:21	-212802639	SSALT
021	1993-104T10:07:52	-211945928	124.86
022	1993-114T08:06:24	-211089216	124.76
023	1993-124T06:04:55	-210232505	124.66
024	1993-134T04:03:27	-209375793	124.57
025	1993-144T02:01:58	-208519082	124.48
026	1993-154T00:00:30	-207662370	124.40
027	1993-163T21:59:01	-206805659	124.33
028	1993-173T19:57:33	-205948947	124.29
029	1993-183T17:56:05	-205092235	124.27
030	1993-193T15:54:36	-204235524	124.26
031	1993-203T13:53:08	-203378812	SSALT
032	1993-213T11:51:39	-202522101	124.29
033	1993-223T09:50:11	-201665389	124.33
034	1993-233T07:48:42	-200808678	124.37
035	1993-243T05:47:14	-199951966	124.45
036	1993-253T03:45:45	-199095255	124.53
037	1993-263T01:44:17	-198238543	124.62
038	1993-272T23:42:48	-197381832	124.72
039	1993-282T21:41:20	-196525120	124.82
040	1993-292T19:39:51	-195668409	124.94
041	1993-302T17:38:23	-194811697	SSALT
042	1993-312T15:36:55	-193954985	125.18
043	1993-322T13:35:26	-193098274	125.31
044	1993-332T11:33:58	-192241562	125.43

Cycle	Cycle midpoint date & time	Cycle midpoint J2000 seconds	Additive corr to GDR range, mm
045	1993-342T09:32:29	-191384851	125.56
046	1993-352T07:31:01	-190528139	125.70
047	1993-362T05:29:32	-189671428	125.85
048	1994-007T03:28:04	-188814716	126.01
049	1994-017T01:26:35	-187958005	126.17
050	1994-026T23:25:07	-187101293	126.34
051	1994-036T21:23:38	-186244582	126.52
052	1994-046T19:22:10	-185387870	126.72
053	1994-056T17:20:42	-184531158	126.93
054	1994-066T15:19:13	-183674447	127.15
055	1994-076T13:17:45	-182817735	SSALT
056	1994-086T11:16:16	-181961024	127.60
057	1994-096T09:14:48	-181104312	127.83
058	1994-106T07:13:19	-180247601	128.06
059	1994-116T05:11:51	-179390889	128.30
060	1994-126T03:10:22	-178534178	128.53
061	1994-136T01:08:54	-177677466	128.75
062	1994-145T23:07:25	-176820755	128.98
063	1994-155T21:05:57	-175964043	129.21
064	1994-165T19:04:28	-175107332	129.45
065	1994-175T17:03:00	-174250620	SSALT
066	1994-185T15:01:32	-173393908	129.94
067	1994-195T13:00:03	-172537197	130.19
068	1994-205T10:58:35	-171680485	130.46
069	1994-215T08:57:06	-170823774	130.73
070	1994-225T06:55:38	-169967062	131.00
071	1994-235T04:54:09	-169110351	131.27

Cycle	Cycle midpoint date & time	Cycle midpoint J2000 seconds	Additive corr to GDR range, mm
072	1994-245T02:52:41	-168253639	131.54
073	1994-255T00:51:12	-167396928	131.84
074	1994-264T22:49:44	-166540216	132.20
075	1994-274T20:48:15	-165683505	132.56
076	1994-284T18:46:47	-164826793	132.85
077	1994-294T16:45:18	-163970082	133.12
078	1994-304T14:43:50	-163113370	133.41
079	1994-314T12:42:22	-162256658	SSALT
080	1994-324T10:40:53	-161399947	134.09
081	1994-334T08:39:25	-160543235	134.41
082	1994-344T06:37:56	-159686524	134.68
083	1994-354T04:36:28	-158829812	134.95
084	1994-364T02:34:59	-157973101	135.24
085	1995-009T00:33:31	-157116389	135.59
086	1995-018T22:32:02	-156259678	135.96
087	1995-028T20:30:34	-155402966	136.30
088	1995-038T18:29:05	-154546255	136.61
089	1995-048T16:27:37	-153689543	136.91
090	1995-058T14:26:09	-152832831	137.24
091	1995-068T12:24:40	-151976120	SSALT
092	1995-078T10:23:12	-151119408	138.02
093	1995-088T08:21:43	-150262697	138.38
094	1995-098T06:20:15	-149405985	138.70
095	1995-108T04:18:46	-148549274	139.00
096	1995-118T02:17:18	-147692562	139.34
097	1995-128T00:15:49	-146835851	SSALT
098	1995-137T22:14:21	-145979139	140.11

Cycle	Cycle midpoint date & time	Cycle midpoint J2000 seconds	Additive corr to GDR range, mm
099	1995-147T20:12:52	-145122428	140.45
100	1995-157T18:11:24	-144265716	140.76
101	1995-167T16:09:55	-143409005	141.07
102	1995-177T14:08:27	-142552293	141.40
103	1995-187T12:06:59	-141695581	SSALT
104	1995-197T10:05:30	-140838870	142.16
105	1995-207T08:04:02	-139982158	142.52
106	1995-217T06:02:33	-139125447	142.86
107	1995-227T04:01:05	-138268735	143.21
108	1995-237T01:59:36	-137412024	143.59
109	1995-246T23:58:08	-136555312	144.01
110	1995-256T21:56:39	-135698601	144.42
111	1995-266T19:55:11	-134841889	144.80
112	1995-276T17:53:42	-133985178	145.14
113	1995-286T15:52:14	-133128466	145.49
114	1995-296T13:50:45	-132271755	SSALT
115	1995-306T11:49:17	-131415043	146.26
116	1995-316T09:47:49	-130558331	146.66
117	1995-326T07:46:20	-129701620	146.99
118	1995-336T05:44:52	-128844908	147.31
119	1995-346T03:43:23	-127988197	147.63
120	1995-356T01:41:55	-127131485	148.00
121	1995-365T23:40:26	-126274774	148.41
122	1996-010T21:38:58	-125418062	148.80
123	1996-020T19:37:29	-124561351	149.17
124	1996-030T17:36:01	-123704639	149.49
125	1996-040T15:34:32	-122847928	149.84

Cycle	Cycle midpoint date & time	Cycle midpoint J2000 seconds	Additive corr to GDR range, mm
126	1996-050T13:33:04	-121991216	SSALT
127	1996-060T11:31:36	-121134504	150.68
128	1996-070T09:30:07	-120277793	151.10
129	1996-080T07:28:39	-119421081	151.47
130	1996-090T05:27:10	-118564370	151.82
131	1996-100T03:25:42	-117707658	152.18
132	1996-110T01:24:13	-116850947	152.58